- IEEE 1991 reference [B10] identifies children and women as being more at risk to startle responses or RF burns, again due to their generally smaller body size.

- An EPA 1984 peer reviewed report and its EPA scientific advisory board have agreed that epidemiology studies clearly identify the elderly and infants and being especially sensitive to thermal stress.

- One of the 2 physicians on the IEEE 1991 committee identified those more susceptible to infection (e.g. diabetics) and those with poor circulatory function (e.g. with cardivascular disease) as being at special risk.

#2 To see that the fixed 6 minute exposure duration of the previous RF standard (ANSI C95.1-1982 was a significant risk, one only need recognize why IEEE 1991 has shortened the duration at the very high frequencies. This is to prevent a short burst of high power causing a skin burn, while still having the average power over 6 minutes meet the average power density criteria. For the ANSI 1982 maximum frequency of 100,000 MHz, the IEEE 1991 time duration for averaging power density is 37 seconds vs. the 6 minutes (360 seconds) of ANSI 1982.

Thus, under ANSI 1982 there could be a 3 second burst of 600 milliwatts per sq. cm of power which could cause a burn, but still meet the ANSI 1982 standard [(3 x 600)/360 seconds = 5 mW/sq. cm average, which = the limit of 5 mW/sq. cm.], but this would not meet the standard of IEEE 1991 [since 3x 600 /37 seconds = 48 mW/sq. cm which exceeds the limit of 10].

#3. Evidence of RF cummulative effects: The IEEE final list paper by Thomas and Maitland (1979, IEEE final list paper on page 67), on "Microwave Radiation and Dextroamphetamine: Evidence of Combined Effects on Behavior of Rats," tested the interaction of dextroamphetamine, a commonly used medication for Attention Deficit Disorder in children and adults, with RF.

Rats were exposed 4 days a week, but given medication and then tested on a day different from a day of exposure. Thus, a day passed between exposure to RF and any learning skills tests. The author attributed the finding of a significant decrease in the ability of exposed animals to correctly respond under some conditioins as due to the cummulative effect of RF. Exposure was at "non-thermal" conditions, being 5% of the IEEE hazard threshold, so no generalized thermal stress would be expected.

#4. Evidence of RF effect due to pulsed or modulated signal. Consider the IEEE final list paper by Thomas, Schrot, and Banvard (1982, on IEEE 1991 final list page 67) "Comparative Effects of Pulsed and Continuous-Wave 2.8 GHz Microwaves on Temporally Defined Behavior." Authors conclude that there was a clear and consistent effect whereby at the same power density, the pulsed signals had a greater impact on causing a deficit in performace. Hence, based on this paper which was screened by IEEE 1991 to assure reliable scientific data, it is clear there is evidence for the effect of pulsed signals being different than continuous wave signals.

letter of D. Fichtenberg to Chairman Hundt, July 30, 1996

Basic protections provided in the FCC standard need to extend beyond SAR to include body temperature and its changes: The principal of developing a protectioin standard on the basis of the specific absorbed rate (SAR) of RF energy per kilogram of body weight has weaknesses, even in the range where SAR applies. This is because the fundamental principal underlying the SAR approach is that it ultimately is the rise in body temperature, whole body or localized, which is the dominant factor for many adverse thermal effects. Consequently, the standard should provide a basic protection provision to protect against certain rises in body temperature. Thus, for example, in hospitals where people may have fever and already exceed safe temperatures, the FCC allowable limits for SAR may be more restrictive - and may apply to private systems to be built in any medical facility

The FCC standard should state that it is a basic provision of the standard that localized SAR limits apply to any 1 gram of continuous tissues (a concern mentioned in the Exposure and Dosimetry panel of the 1993 EPA RF Radiation Conference.

See Exhibit 2 pg. 16 of Exhibit. That mentions this issue

letter of D. Fichtenberg to Chairman Hundt, July 30, 1996

Reject the IEEE 1991 clain that its limits "should be safe for all" [IEEE 1991, pg. 23] and that reject that its maximum permissible exposure (MPE) limits are values "to which a person may be exposed without harmful effect and with an acceptable safety factor."

Considering the number of observed adverse effects which occurred below the IEEE hazard threshold and adverse effects even occuring at exposures deemed safe by IEEE 1991. Also consider the limitations of IEEE 1991 limits noted within IEEE 1991 itself and by others. It therefore follows its claims of being safe for all and allowing exposures "to which a person may be exposed without harmful effect" is unwarrented

Indeed, NIOSH reports,

"The exposure level that woud be set by the standard are based on only one dominant mechanism - - adverse health effects causeed by body heating." [NIOSH letter of Jan. 11 from R. Niemeier to the FCC]

Also, FDA reports, *"In our opinion, it is unclear what types of bioloIgical effects and exposure conditions are addressed by the standard."* [FDA letter of Nov 10, 1993 of L. Gill to FCC]

Similarly, EPA reports, *"The limitations of the data used to define the adverse effect level ..do not support the claim that the recommended MPEs ..are protective of all mechanisms and all people,"* and that *"The thesis that the 1992 ANSI/IEEE recommendations are protective of all m echanisms is unwarranted because the adverese effects level in the 1992 ANIS/IEEE standard is based on a thermal effect."* [EPA letter of Nov 9, 1993 from M. Oge to FCC, pg. 3 of letter and 5 of comments]

Some supporters of IEEE 1991 disagree with the above claims and argue that all effects from RF exposures were considered, and may even cite studies from the IEEE final list of papers which studied effects below thermal exposure levels. However, as was shown above, IEEE 1991 documents at least 11 studies in which adverse effects occurred at exposure levels below that 'hazard threshold' selected by IEEE 1991. Because IEEE 1991 decided to select a hazard threshold which actually far exceeded exposures at which there were some adverse effects within the 120 final list papers, this IEEE decision supports the claims of NIOSH and EPA that only effects due to thermal exposure were given consideration when determining the IEEE hazard threshold.

Since IEEE 1991 states,

"The existing MPE's are based on the threshold for behavioral disruption with acute exposures of experimental animals," [IEEE 1991 pg 29] and elsewhere describes these animals as including "rodents" such as rats [IEEE 1991 pg. 27],

but as it is seen, disruption of learned skills occurred to rats below the IEEE 1991 hazard level for studies on the IEEE 1991 final list. Hence, it is unclear how the IEEE hazard level was determined or for what its MPE limits provide protection

Recommendation: The FCC must follow the recommendations and findings of the federal health agencies and the information offered here - e.g. the IEEE limits are far from "safe for all".

It is essential that within the Final Rule the letters of the Federal Health agencies be included so it their own words the FCC will fulfull the NCRP 1986 requirement, of

"fully informing the worker and public of the limits of knowledge." [NCRP 1986, pg 278]

Not only is there much that is uncertain, there is also much that is known, and that is there is sufficient evidence that IEEE 1991 exposure limits are far too high, given the evidence of observed adverse effects and the levels at which they are occuring.

Therefore, adopt a policy of keeping exposures as low as reasonably achievable. Notifiy local jurisdictions that there may well be a health issue, and that they need to tell the public to keep the antennas high.

To this end explore to what extent can satellites help in providing very low transmission exposure, and function together with ground based-receive only antennas who can then resend the signal to the satellites?

Give local jurisdictions the authority to implement the ALARA principle, and the authority to act soon if there are new findings.

Tnank you.

EXHIBIT #1

These 2 examples show that cellular base stations in urban areas & at low heights can still put out enough power to cause an out-of compliance condition or be at the limit

So: DO NOT CATEGORICALLY EXEMPT cellular Base Stations
Also many small ones can cause problem.
& a single one close to homes can cause problems.

Please NO CATEGORICAL EXEMPTIONS

near stores | A 45 foot high building 43 feet away would get FCC limit | 45 feet Seattle, Washington 3000 watt ERP

01/25/95 16:19 US WEST NEWVECTOR (ENG.) 005

Cellular Power Density for the Laurelhurst Cell Site.

Prepared by Roy Norgaard 11/07/94

Antenna Height: 45 feet ERP/Chan: 100 watts
Measurement Ht 6 feet Antenna: DB 833R
Number of Radio Ch 30

Distance From Tower (Feet)	Adjusted Vertical Elevation (Feet)	Angle Below Horizon (degrees)	Antenna Vertical Pattern (dB)	Distance From Antenna (Feet)	Channels Power Density (uW/cm^2)	% of Revised ANSI Standard (580uW/cm^2)	Comments:
0	0	90.0	-29.0	39.0	0.923	0.1564%	
5	0	82.7	-29.0	38.3	0.906	0.1535%	
10	0	75.6	-28.8	40.3	1.420	0.2408%	
20	0	62.9	-20.1	43.8	5.671	0.9612%	
30	0	52.4	-15.3	49.2	13.580	2.3033%	
40	0	44.3	-12.2	55.8	21.823	3.6980%	stores along Sand Point Way
50	0	38.0	-10.7	63.4	23.811	4.0469%	stores along Sand Point Way
60	0	33.0	-11.1	71.6	16.806	2.8642%	
70	0	29.1	-13.6	80.1	7.238	1.2267%	
80	0	26.0	-19.0	89.0	1.772	0.3003%	
90	0	23.4	-14.0	98.1	4.613	0.7819%	
100	0	21.3	-11.1	107.3	7.511	1.2731%	
110	0	19.5	-9.0	116.7	10.304	1.7464%	
120	0	18.0	-8.0	126.2	11.096	1.8810%	
130	0	16.7	-8.1	135.7	15.028	2.5471%	
140	0	15.6	-8.2	145.3	15.940	2.7017%	
150	0	14.6	-8.5	155.0	16.467	2.7910%	
160	0	13.7	-3.9	164.7	16.746	2.8382%	
170	0	12.9	-3.1	174.4	18.157	3.0774%	Thriftway parking lot
180	0	12.2	-3.1	184.2	16.283	2.7596%	
190	0	11.6	-2.5	194.0	16.084	2.7258%	
200	0	11.0	-2.5	203.9	15.099	2.5591%	
225	0	9.8	-1.8	228.4	14.288	2.4216%	
250	0	8.9	-1.3	253.0	12.909	2.1879%	
275	0	8.1	-1.3	277.6	10.713	1.8157%	
300	0	7.4	-0.9	302.5	9.901	1.6782%	
325	0	6.8	-0.8	327.3	8.654	1.4668%	
350	0	6.4	-0.6	352.2	7.477	1.2672%	
375	0	5.9	-0.3	377.0	7.319	1.2408%	
400	0	5.6	-0.3	401.0	6.441	1.0918%	
450	0	5.0	-0.1	451.7	5.340	0.9051%	
500	0	4.5	-0.1	501.6	4.331	0.7341%	
600	0	3.7	0.0	601.3	3.064	0.5227%	
700	0	3.2	0.0	701.1	2.266	0.3844%	
800	0	2.8	0.0	801.0	1.738	0.2946%	
900	0	2.5	0.0	900.8	1.374	0.2329%	
1000	0	2.2	0.0	1000.8	1.113	0.1887%	
1500	0	1.5	0.0	1500.5	0.495	0.0839%	
2000	0	1.1	0.0	2000.4	0.279	0.0472%	
2500	0	0.9	0.0	2500.3	0.178	0.0302%	
3000	0	0.7	0.0	3000.3	0.124	0.0210%	
4000	0	0.5	0.0	4000.2	0.070	0.0118%	
5000	0	0.4	0.0	5000.2	0.045	0.0076%	

Assumptions:

1.) "B-Band" Cellular Transmitter Frequencies are 880.02 to 893.85 MHz

2.) All exposures will be in the far-field region since the longest wavelength is 14 inches

3.) Exposures include 64% reflected energy from the ground

4.) Calculations are worst case based on theoretical antennas that provide maximum gain for 360 degrees in the horizontal plane

A building 43 feet away and 45 feet high would get an exposure of 580 $\mu w/cm^2$

The IEEE standard limit

So cellular antennas can put out much exposure

near apartments

Seattle. Washington 35 feet 3000 watt ERP

[redacted] 94 10:27 FROM WIRELESS SYS ENG TO 93280815 PAGE

Cellular Power Density for the Edgewater Cell Site.

Prepared by Ray Norgaard 10/11/94

Antenna Height: 35 feet
Measurement Ht: 6 feet
Number of Radio Chs: 30

ERP/Chan: 100 watts
Antenna: DB 833R

Distance From Tower (Feet)	Adjusted Vertical Elevation (Feet)	Angle Below Horizon (degrees)	Antenna Vertical Pattern (dB)	Distance From Antenna (Feet)	Channels Power Density (uW/cm^2)	% of Revised ANSI Standard (600uW/cm^2)	Comments:
0	0	90.0	-28.0	29.0	1.000	0.1666%	
5	0	80.2	-28.0	29.4	1.021	0.1767%	
10	0	71.0	-26.0	30.7	2.870	0.4784%	
20	0	55.4	-17.0	36.2	17.884	2.9807%	
30	10	38.3	-11.6	38.6	58.469	10.4911%	2nd floor of all apartment
40	0	36.9	-10.8	49.4	36.427	6.0121%	1st floor of all apartment
50	0	30.1	-12.5	57.8	18.784	3.1307%	
60	0	26.8	-19.0	66.6	3.100	0.5166%	
70	0	22.5	-12.5	75.8	11.435	1.9061%	
80	0	19.9	-9.0	85.1	19.382	3.2301%	
90	0	17.9	-7.0	94.6	24.679	4.1167%	
100	0	16.2	-6.1	104.1	26.686	4.4477%	
110	0	14.8	-4.8	113.8	30.688	5.1147%	
120	0	13.6	-3.9	123.6	28.788	4.7980%	
130	0	12.6	-3.1	133.2	31.133	5.1889%	
140	0	11.7	-2.5	143.0	30.689	5.1149%	
150	0	10.9	-2.0	152.8	30.139	5.0231%	
160	0	10.3	-2.0	162.6	26.688	4.4480%	
170	0	9.7	-1.6	172.5	26.088	4.3480%	
180	0	9.2	-1.6	182.5	22.416	3.7361%	
190	0	8.7	-1.5	192.2	22.272	3.7121%	
200	0	8.3	-1.5	202.1	20.826	3.4710%	
250	0	7.3	-0.9	252.0	17.007	2.8345%	
260	0	6.8	-0.8	261.7	14.488	2.4813%	
275	0	6.0	-0.8	276.5	12.127	2.0212%	
300	0	5.6	-0.3	301.4	11.463	1.9105%	
325	0	5.1	-0.3	326.3	9.772	1.6287%	
350	0	4.7	-0.1	351.2	8.663	1.4771%	
375	0	4.4	-0.1	376.1	7.791	1.2985%	
400	0	4.1	-0.1	401.0	6.775	1.1292%	
450	0	3.7	0.0	450.9	5.483	0.9138%	
500	0	3.3	0.0	500.8	4.444	0.7406%	
600	0	2.8	0.0	600.7	3.080	0.5133%	
700	0	2.4	0.0	700.6	2.271	0.3785%	
800	0	2.1	0.0	800.5	1.740	0.2900%	
900	0	1.9	0.0	900.5	1.376	0.2293%	
1000	0	1.7	0.0	1000.4	1.114	0.1857%	
1500	0	1.1	0.0	1500.3	0.486	0.0810%	
2000	0	0.8	0.0	2000.2	0.279	0.0465%	
2500	0	0.7	0.0	2500.2	0.178	0.0302%	
3000	0	0.6	0.0	3000.1	0.124	0.0207%	
4000	0	0.4	0.0	4000.1	0.070	0.0118%	
5000	0	0.3	0.0	5000.1	0.045	0.0076%	

If a 35 foot high Building were 43 feet or less away then exposures would be expected to reach FCC prepared limits

Assumptions:

1.) "B-Band" Cellular Transmitter Frequencies are 880.02 to 893.85 MHz.

2.) All exposures will be in the far-field region since the longest wavelength is 14 inches.

3.) Exposures include 64% reflected energy from the ground.

4.) Calculations are worst case based on theoretical antennas that provide maximum gain for 360 degrees in the horizontal plane.

From: Federal Focus National Symposium on Wireless Transmission Base Facilities Station Oct. 1994

BASE STATION EXPOSURES AT CELLULAR FREQUENCIES

Standard	General-Public Limit (averaged over 30 minutes)	Occupational Limit (averaged over six minutes)	Typical ambient level	Typical ground-level maximum exposure	Typical exposure 30 inches from antenna proper
1982 ANSI	2900 μW/cm²	Same	0.0005%	0.034%	103%
1992 ANSI	580 μW/cm²	2900 μW/cm²	0.0025% GP 0.0005% O	1.7% GP 0.034% O	517% GP 103% O
1986 NCRP	580 μW/cm²	2900 μW/cm²	0.0025% GP 0.0005% O	1.7% GP 0.035% O	517% GP 103% O
1986 NCRP with modulation derating	580 μW/cm²	580 μW/cm²	0.0025%	1.7%	517%
1987 IRPA	435 μW/cm²	2175 μW/cm²	0.0034% GP 0.0007% O	0.2% GP 0.046% O	690% GP 138% O

This shows • Base station exposure limits can be set Low without interfering with the industry.

DISTANCES TO ACCEPTABLE EXPOSURES FROM BASE STATION ANTENNAS

The following table shows distances, as a function of ERP, to the power flux densities permitted by standards discussed at the Federal Focus Symposium. The underlying calculations assume no reflection or absorption, 15 active channels, and omnidirectional antennas. Actual base stations tend to emit less signal power downward than outward, so the table probably overstates real exposures at the base of a tower. Because most base-station antennas are 150 feet or so in the air, minimum distances to both the general-public and occupational limits are more than satisfied. Fewer channels (less exposure) or more channels (more exposure) may be active at a given base station than the 15 channels assumed

Standard	General-Public Limit	Distance to General-Public Limit	Occupational Limit	Distance to Occupational Limit
1982 ANSI	2900 μW/cm²	15.0 ft. (500 W) 10.5 ft. (250 W) 6.7 ft. (100W) 4.7 ft. (50 W) 3.0 ft. (20 W)	Same As General	Same As General
1992 ANSI	580 μW/cm²	33.0 ft. (500 W) 23.5 ft. (250 W) 14.9 ft. (100W) 10.5 ft. (50 W) 6.7 ft. (20 W)	2900 μW/cm²	15.0 ft. (500 W) 10.5 ft. (250 W) 6.7 ft. (100W) 4.7 ft. (50 W) 3.0 ft. (20 W)
1986 NCRP	580 μW/cm²	33.0 ft. (500 W) 23.5 ft. (250 W) 14.9 ft. (100W) 10.5 ft. (50 W) 6.7 ft. (20 W)	2900 μW/cm²	15.0 ft. (500 W) 10.5 ft. (250 W) 6.7 ft. (100W) 4.7 ft. (50 W) 3.0 ft. (20 W)
1986 NCRP with Modulation Derating	N/A	N/A	580 μW/cm²	33.0 ft. (500 W) 23.5 ft. (250 W) 14.9 ft. (100W) 10.5 ft. (50 W) 6.7 ft. (20 W)
1987 IRPA	435 μW/cm²	38.4 ft. (500 W) 27.2 ft. (250 W) 17.2 ft. (100W) 12.2 ft. (50 W) 7.7 ft. (20 W)	2175 μW/cm²	17.2 ft. (500 W) 12.2 ft. (250 W) 7.7 ft. (100W) 5.4 ft. (50 W) 3.4 ft. (20 W)

• This shows exposure can exceed limits & need to be checked.

Exhibit #2

This shows the RF modulated at ELF of Power lines may even be much more potentially dangerous.

Therefore

- Keep Magnetic fields low
- Implement "As Low As Reasonably Achievable" ALARA.
- Give Local Jurisdictions Authority to implement ALARA.

United States Environmental Protection Agency
Office of Air and Radiation & Office of Research and Development
402-R-95-009
March 1995

EPA

Summary and Results of the April 26-27, 1993 Radiofrequency Radiation Conference

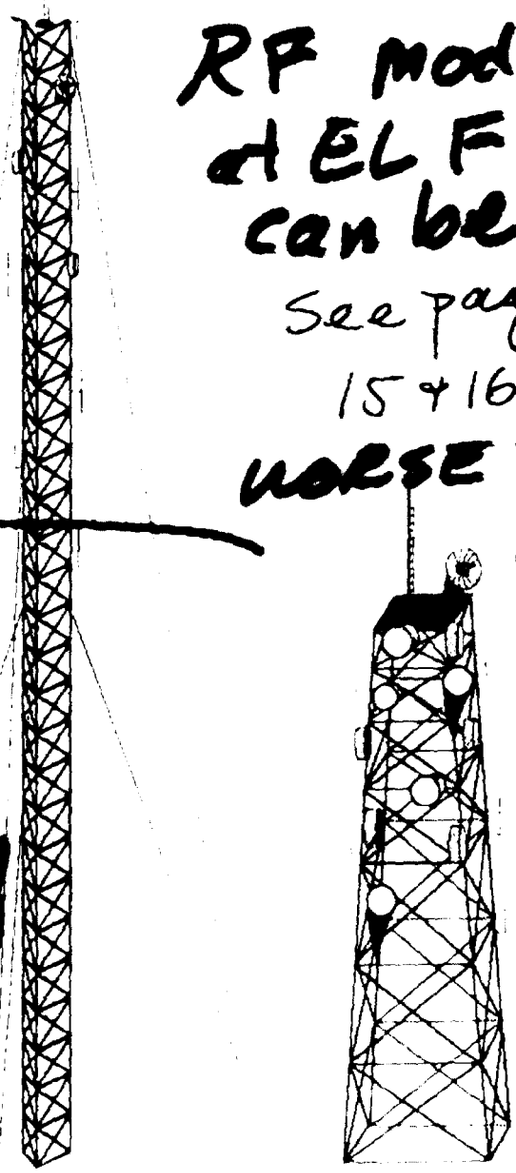
Volume 1: Analysis of Panel Discussions

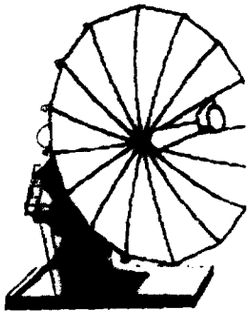
THIS shows that RF modulated at ELF can be much

See pages 15 & 16, 17

worse Than ELF

so Don't Increase Magnetic Fields





402-R-95-009
March 1995

Summary and Results of the April 26-27, 1993 Radiofrequency Radiation Conference

Volume 1: Analysis of Panel Discussions

Prepared for

Office of Air and Radiation
and Office of Research and Development
U.S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

Under Contract

Nos. 68-D0-0102 and 68-D2-0177

PANEL 1: EXPOSURE AND DOSIMETRY (EXPOSURE ASSESSMENT, DOSIMETRY, RF SHOCKS AND BURNS)

Mr. Edwin Mantiply (Chair)
Dr. C. K. Chou
Dr. Robert F. Cleveland, Jr.
Dr. David L. Conover
Dr. Carl H. Durney
Dr. Om P. Gandhi
Dr. A. William Guy
Dr. Ronald C. Petersen

INTRODUCTION

Panel 1 focused on exposure assessment and dosimetry issues. This panel also discussed several issues raised by speakers — primarily Mantiply, Guy, and Gandhi (see Volume 2) — during the plenary session. The topics on which Panel 1 focused included:

- RF radiation dosimetry;
- The relationship between continuous and pulse- and FM-modulated RF radiation exposure; and
- Adoption of a standard.

RF RADIATION DOSIMETRY

The panel noted the importance of RF radiation dosimetry in the assessment of biological effects, whether thermal or nonthermal. Considered in broad terms, dosimetry was characterized as the association of external fields with the internal fields in the tissues, and it involves the description of all exposure parameters and the relation to specific absorption rate (SAR), internal electric and magnetic fields, and internal current densities.

The panel divided their discussion of dosimetry into three categories: (1) use of SAR in RF radiation dosimetry; (2) progress in dosimetry; and (3) the need for better dosimetric methods.

Use of SAR

SAR was considered by much of the panel to apply to both thermal and athermal effects, and was generally felt to be the most important physical quantity associated with dosimetry. The panelists discussed several controversies, however, over the use of SAR as a means — especially the sole means — of quantifying effects. At low frequencies, for example, most panelists felt that SAR is meaningless since individuals may be electrocuted with negligible SARs (i.e., shocks and burns are related to current density). Conversely, one panelist noted that SAR can be quite high with negligible levels of current. The consensus of the panel was that all parameters (i.e., current densities, internal fields, and SAR) should be described when discussing RF radiation effects.

Progress in Dosimetry

Significant progress was reported and discussed in the area of local dosimetry of contact currents, nonuniform fields, multiple sources, and small sources. There are new technologies and higher spatial resolution models to use for assessing dose. These new methods should be included in any update of the 1984 RFR Report on the biological effects of RF radiation. Several panelists also agreed that the 1984 RFR Report — perhaps Conclusion #3, which addressed the

thermoregulatory effects of RF radiation (see Appendix A) should be updated to emphasize the use of averaging time for shocks and burns.

Need for Better Dosimetric Methods

Several recommendations were made for improving existing dosimetric methods.

- There is a need for more spatial or three-dimensional SARs, since local SARs may be up to 100 times higher than the whole body average SARs.
- Develop approaches for combining local SAR criteria (e.g., for personal communication devices) with power density limits for far-field whole body exposure.
- To help biologists address mechanisms, more emphasis must be placed on microdosimetry.
- In general, physical scientists must work more closely with biologists in improving dosimetric methods used in studies.

RELATIONSHIP BETWEEN CONTINUOUS WAVE AND PULSE- AND ELF-MODULATED EXPOSURE

The panel focused on the interest in an approach to assessing the relationship between continuous wave and pulse- and ELF-modulated exposure.

Assessing Continuous vs. Pulse- and ELF-Modulated Waves Exposure

The differences between the effects from continuous and pulse- and ELF-modulated RF radiation were discussed by the panelists. One panelist cited research that indicates that pulse-modulated RF radiation produces effects at nonthermal SARs, while continuous wave RF radiation at the same SARs does not produce these effects. Most panelists felt that important questions are raised with regard to time-averaged SAR and the need for different dose measures for modulated and continuous wave RF radiation.

One of the panelists proposed an approach that may address the relationship between continuous wave and pulse- and ELF-modulated RF radiation. This approach is based on a Fourier series expansion of the RF radiation pulse train. The summation of the SARs found for each Fourier series sinusoidal harmonic of the pulse train would be a way to connect to the results of exposure to the continuous wave case. This panelist noted, however, that the validity of this approach would depend on the interaction mechanism (e.g., the approach may not be completely valid if the response mechanism is nonlinear), and as yet there is no information on the response mechanisms associated with modulated RF radiation.

Linking ELF Radiation Research to ELF-Modulation of RF Radiation

A significant amount of discussion addressed ELF-modulated RF radiation issues, primarily those related to linking ELF and ELF-modulated RF radiation research. One panelist described the difference between the internal fields from "direct" ELF (e.g., from power lines) and fields generated from RF radiation, where the latter fields are much greater (by as much as 100,000 times). Thus, the panelist noted, the internal ELF fields from ELF-modulated RF radiation may be more significant than from direct ELF. Another panelist commented that effects due to ELF-modulated RF radiation

that are similar to direct ELF fields have been observed experimentally, although the results have not been conclusive. The panelists agreed that ELF-modulated RF radiation exposure is an important area, but that significant additional research is needed before any conclusions can be reached.

ADOPTION OF EXPOSURE STANDARDS

The panel strongly recommended that EPA adopt some form of an exposure standard, such as the ANSI/IEEE standard. During discussion of this recommendation, the panel addressed several issues or points, including deficiencies/limitations of the ANSI/IEEE standard, cost implications, and performance standards.

Deficiencies or Limitations in the ANSI/IEEE Standard

The panel felt that the ANSI/IEEE standard should be updated to correct the following deficiencies/limitations as more data becomes available:

- Averaging time for contact current. Some panelists felt that the standard's 1 second averaging time should be used only below 100 kHz (to protect against shock), and that a longer averaging time could be used for frequencies above 100 kHz and up to 100 MHz.

- Transient discharges. Panelists agreed that transient discharge, which is a problem that occurs during contact with an object containing an RF voltage, results in a pulse of current that can cause a shock or a short-term burn. Little information on transient discharges as a function of frequency exists, however, and therefore the standard should more clearly address limitations in protection against shocks or burns due to transient discharge.

- Calculating SAR for a cubic shapes of tissue. Some panelists felt that there are certain problems with calculating SAR for 1 or 10 grams of tissue in the shape of a cube, since certain parts of the body, such as the ear lobe or the hand holding a device, cannot be identified as cube shaped.

- Frequency cutoff. Some panelists noted that the frequency cutoff for induced and contact currents of 100 MHz may result in certain problems (e.g., for assessing mixtures of exposure) because the FM radio band is 88 to 108 MHz.

- Conflicting components of standard. One panelist noted that the standard allows the possibility of compliance with electric field strength, but not with induced current limit at some frequencies.

Cost Implications of Standard

The panel identified some of the cost implications of adopting the ANSI/IEEE standard. In addition to the potential impact on the FM radio industry because of the 100 MHz cutoff, the body current limitations could significantly increase the cost of AM broadcast compliance. In addition, the panel noted, FM stations that are in compliance now with the 1982 ANSI standard may not be with the 1992 standard.

Using the ANSI/IEEE Standard to Develop Performance Standards

Suggestions were made to use the ANSI/IEEE standard as a cap on environmental exposure, and then establish case-by-case performance standards to achieve lower fields for particular sources where it may be easy to limit exposure down to levels lower than the standard (e.g., raising the height of radar devices on pleasure boats to reduce exposure).

CONCLUSIONS/RECOMMENDATIONS

The panel discussed several of the major advantages and disadvantages of SAR. SAR was generally considered to be the most important dosimetric quantity applicable to both thermal and athermal effects. The panel also highlighted several areas — including contact currents, nonuniform fields, multiple sources, and small sources — in which major improvements have taken place recently in the field of dosimetry. Furthermore, the panel identified areas for additional dosimetry research, such as spatial or three-dimensional SARs, combining local SAR criteria (e.g., for personal communication devices) with power density limits for far-field whole body exposure; and microdosimetry.

The panel addressed several issues associated with pulse- and ELF-modulated RF radiation, including potentially lower thresholds for effects from these fields compared to continuous wave RF radiation; the possible relevance of ELF research to effects of ELF-modulated RF radiation; and the additional research that is needed overall. The panel also concluded that some changes were needed in the 1987 Reassessment Report (see Appendix A), including updates on new methods for exposure assessment and dosimetry; and an update of electric shock and burn (perhaps for Conclusion #3). The panel also strongly recommended that EPA adopt RF radiation exposure guidelines, such as the ANSI/IEEE standard (or some form of it).

Exhibit #3

IEEE Balloting

Issues

Reasons why

66% (2 of 3) from

Health Agencies voted

against IEEE 1991.

- See letters of those voting "No" on page 3-5
- see Ballot list on page 3-8

Excerpt from Report

1. Credibility problems due to IEEE unbalanced voting and inadequate review process.

Inadequate balance of interests: The IEEE development and voting process weakened the credibility of the standard. This is because the balloting committee lacked sufficent public health representation with only 3 of 36 members being from a public health agency (all from the Food and Drug Administration (FDA) Center for Device and Radiological Health), while 31 were users of radio frequency or consultants or contractors to users (27 voted) See distribution below.

Balloting Committee for IEEE 1991 by company association 36 members, 32 voted

31 Users of Radio Frequency or contractors or consultants to users (27 voted)

	16	Dept. of Defense (Army 4, Navy 7, Air Force 5)
	7	Private companies(not utlitities) and private consultants (e.g. AT&T Bell Labs, Motorola, Raytheon Research)
	3	Utilities (Florida Power & Light, Houston Power and Light, New York Power)
	5	Universtiy departments or laboratories of physics, engineering, bioengineering, bioelectromagnetics (presumably contractors and consultants to users)
3	3	Health agency representatives (all FDA Center for Device and Radiological Healht
2	2	Other: 1 University + NIST (National Inst. for Standards and Technology of Dept. of Commerce - a user of RF

66% (2 of 3) IEEE members from health agencies (the FDA) voted to against adoption of IEEE 1991 (Dr. Mays Swicord and Dr. M. Altman) Explaining his negative vote, Dr. Swicord wrote, and Dr. Altman concurred, that,

"I feel that the procedures agreed upon concerning membership and circulation of this document have not been fully carried out. A membership committee was appointed to consider proper balance of representatives. To my knowledge this committee never met. It is generally recognized that current membership is not balanced in representing government (e.g. regulatory health agencies), *industry* (e.g. users of radio-frequency), *and the general public. Thus, the ballot may not represent a proper balance."* [see IEEE ballot and comments attached].

Lack of public health perspective: The above lack of balance also disturbed the National Institutes of Occupational Safety and Health (NIOSH) who wrote the FDA that,

"NIOSH is concerned about the lack of participation by experts with a public health perspective in the IEEE RF standards setting process." [NIOSH letter from R. Niemeier of Jan. 11, 1994 to the FCC]

NIOSH also criticized IEEE 1991 for being weak because it considered few epidemiology studies, and wrote,

"For example, epidemiology studies were categorically rejected as not useful in the process of setting ANSI/IEEE C95.1-1992 limits. This lack of public health perspective creates a weakness in the standard that should be acknowledged by the FCC." [NIOSH letter of Jan. 11, 1994 from R. Niemer to the FCC]

Note that IEEE 1991 did contain one study of RF and heart disease, and found an *adverse* effect [Hamburger et al. 1983 on IEEE final list pg. 64] While supporters of IEEE 1991 claim there

were 11 epidemiology studies, the remaining 10 were short term studies exposing people for minutes or less to determine criteria for induced currents, contact currents, RF burns and perception studies, power absorption in the body, heating effects of short millimeter waves and did not address effects of chronic low level exposure which is of great public health concern. [ ]

Lack of review by health agencies of drafts of IEEE 1991: No agency review of the IEEE draft occurred as had been planned, since Dr. Swicord also wrote,

"Secondly, we agreed at the fall meeting in 1989 to send out this document for agency review and comment... if the standard is to have credibility I feel it is necessary."

Thus, it appears the IEEE 1991 did not follow its own agreed upon procedures to have agencies review and comment on a draft of IEEE 1991

Lack of consistency between exclusion clauses and basic provision of standard: Dr. Swicord wrote as a reason for his "No" vote,

"An inconsistency between the exclusion clause and the basic standard."

Lack of proper justification for allowing increased exposure: Dr Swicord, wrote, with the concurrence of Dr. Altman,

"The standard has been increased at the higher frequencies from the 1982 versions with very weak justification. However, the appearance of arbitrarily increasing the level for practical engineering considerations with no health consideration will cause undue public concern of the committees actions. The justification should be strong and make sense or the values should be reduced to 1982 levels."

Lack of sufficient careful review of the scientific literature: Concerning how well the IEEE 1991 committee reviewed the scientific literature, Dr Swicord expressed concern that important studies on pulsed RF was not getting appropriate attention, and he wrote,

"There is other data (work of Kues and others) which suggests that pulsed microwaves may give responses at lower average levels than CW (continuous wave). This problem should not be brushed aside."

The work of Henry Kues (Kues, 1985, 1992) has shown eye damage (degenerative changes in the retina, iris, and cornea) in monkeys occurs at lower levels with pulsed than with continuous wave signals, and that these occur 65% below the IEEE 1991 selected whole body hazard threshold, and occur 6.5% below this hazard threshold when the glaucoma medication, timolol maleate is given. Also when this glaucoma medication is given, eye damage was observed at 16% of the level deemed safe for localized irradiation of the eye in IEEE 1991.

Note that (Kues, 1985) was on a preliminary list of papers a IEEE 1991 sub-committee evaluated for the selection of the Final List of Papers Reviewed for IEEE 1991. It is not clear why this paper was removed from subsequenct consideration by IEEE 1991.

As noted elsewhere in this report, the FDA, National Institures of Occupational Safety and Health (NIOSH), and EPA concurred with the view that important available studies were not properly considered, and that this weakens IEEE 1991 credibility Likewise, at a 1993 EPA conference, members of an expert panel voiced a concern consistent with this view and noted that current

non-federal standards did not consider important studies. The letter from Dr. Swigard and concurrence by Dr. Altman further substantiate that this indeed some important problems were "brushed aside."

Lack of majority rule prevents elimination of a claim made by IEEE working groups which EPA finds 'unsupported': It is important to note that apparently 'majority rule' was not followed to allow modifying the drafts of IEEE 1991. As a result of a 2/3 majority requirement for changing draft text, a claim which was not supported by an EPA agency peer-reviewed and Scientific Advisory Board reviewed report, nevertheless was able to remain in IEEE 1991. This occurred despite the efforts of Dr. Herbert Pollack, one of the two physicians on the committee reviewing the draft to try to get it deleted. Dr. Joe Ellder, of the EPA and member of IEEE, was reported to have found the vote refusing to eliminate this false claim "incredible." [all the material in this section is based on Microwave News September/October 1989]

Note: the claim in dispute was that "there was no reliable scientific evidence that certain subgroups of the population were at greater risk than others." [IEEE 1991 pg. 23]. But but an EPA report which studied a 16 year period in the U.S. in which there were 5 heat waves found:

1- "...there was an excess of deaths from hypertensive heart disease in May, June, or July in each of the heat wave years but not in 10 of the other 11 years."

2- "Infants below 1 year of age are the most heat-illness-prone age group below 50 years of age; adults above 50 years are more heat-illness prone than infants and become progressively more so with advancing age."

and therefore,
3- "the general population has groups of individuals particularly susceptible to heat." [EPA, 1984,pg. 6-9]

It is not clear why the IEEE 1991 committee did not accept the findings of one of its two physicians nor of the EPA which based its conclusions on science based Vital Statistics Reports of the U.S. Public Health Service.

Consequently, EPA reported in its letter to the FCC that,

"The 1991 ANSI/IEEE conclusion that there is no scientific data indicating certain subgroups are more at risk than others is not supported by NCRP (1986) or EPA reports." [EPA letter to FCC, 1993]

04/17

FOR ACTION

Letter Ballot
of IEEE Standards Coordinating Committee, SCC28
to be submitted for
Approval of the *Revision* of ANSI Standard C95.1-1982,
Draft dated July 1990

American National Standard ***Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz***

Please return this ballot NO LATER THAN - ***April 15, 1991***

_____ Approve (Affirmative) for IEEE Standard; comments on reverse or attached.

__X__ Disapprove (Negative) for reasons given on reverse or attached.
(Note: In accordance with 5.7(2) of the IEEE Standards Manual, this vote must be accompanied by specific reasons in sufficient detail that the specific wording of the changes that will cause the negative voter to change the vote to "Approve" can readily be determined. In the absence of a reason for a negative vote after follow-up inquiry, the ballot shall be classified as "no response.")

An abstention vote must be accompanied with the reason for abstaining; without a reason, an abstention will be classified as an unreturned ballot.

_____ Abstain for lack of time to review document.

_____ Abstain for lack of expertise.

_____ Abstain for _____

Voter Name: (Please type) MAYS L SWICORD Date: 4/18/91

Signature: _____ Phone No.: 301-443-7150

Address: FDA - HFZ 114
5600 FISHERS LANE
ROCKVILLE, MD 20857

Return this original ballot (and comments) to:

R. C. Peterson
AT&T Bell Laboratories
Room 1P101C
Holmdel, NJ 07733
908-582-6442

3-4

Four reasons for rejecting the standard are as follows.

1. I feel that the procedures agreed upon concerning membership and circulation of this document have not been fully carried out. A membership committee was appointed to consider a proper balance of representatives. To my knowledge this committee has not met. It is generally recognized that the current membership is not balanced in representing government, industry and the general public. Thus the ballot may not represent a proper balance. Secondly, we agreed at the fall meeting in 1989 to send out this document for agency review and comment. The second point may be considered minor but if the standard is to have credibility I feel it is necessary.

2. The inconsistency of the exclusion clause with the basic standard.

3. Little attention has been paid to appropriate averaging time. The standard still uses 6 minutes for frequencies below 15 GHz. Six minutes was arbitrarily chosen and has no significance in terms of thermal loading to cells or any other biological response. There is some work by Wachtel which suggest some maximum values for consideration. There is other data (work of Kues and others) which suggest that pulsed microwaves may give responses at lower average levels than CW. This problem should not be brushed aside.

4. The standard has been increased at the higher frequencies from the 1982 versions with very weak justification. There is the statement that this is a standard for the work place and does not include children. However, there are small adults. The factor of two is nothing to be concerned with. However, the appearance of arbitrarily increasing the level for practical engineering considerations with no health consideration will cause undue public concern of the committees actions. The justification should be strong and make sense or the values should be reduced to 1982 levels.

(Signature of Mays Swicord of FDA

3-5

UNRESOLVED NEGATIVE VOTES

FOR ACTION

Letter Ballot
of IEEE Standards Coordinating Committee 28 (SCC28)
to be submitted for
Approval of the Revision of ANSI Standard C95.1-1982.
Draft dated July 1990

American National Standard *Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*

Please return this ballot NO LATER THAN .. *April 15, 1991*

_____ Approve (Affirmative) for IEEE Standard; comments on reverse or attached.

__✓__ Disapprove (Negative) for reasons given on reverse or attached.
(Note: In accordance with 5.7(2) of the IEEE Standards Manual, this vote must be accompanied by specific reasons in sufficient detail that the specific wording of the changes that will cause the negative voter to change the vote to "Approve" can readily be determined. In the absence of a reason for a negative vote after follow-up inquiry, the ballot shall be classified as "no response.")

An abstention vote must be accompanied with the reason for abstaining; without a reason, an abstention will be classified as an unreturned ballot.

_____ Abstain for lack of time to review document.

_____ Abstain for lack of expertise.

_____ Abstain for _____

Voter Name: (Please type) M.R. Attaway, PhD Date: 30 April 91

Signature: _____ Phone No.: _____

Address: _____

_____

_____

_____

Return this original ballot (and comments) to:

R. C. Petersen
AT&T Bell Laboratories
Room 1F101C
600 Mountain Ave.
Murray Hill, NJ 07974
908-582-6462
908-582-7874 (Fax)

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See Comments of Dr. Mays Swicord of FDA.

(comment of Dr. Altman of FDA)

The Institute of Electrical and Electronics Engineers, Inc.

BALLOT SUMMARY

IEEE Project No. C95.1

SPONSOR: SCC-28 BALLOTING COMMITTEE: SCC-28 DATE 05-14-91

NAME	COMPANY	Classification *			Vote			
		*	*	*	Yes	No	Abstain	Not Ret.
Altman, M.R.	FDA/CDRH			R		X		
Baird, R.C.	NIST			AR	X			
Balzano, Q.	Motorola			TC	X			
Barron, N.	Dept. of Navy			A	X			
Brandinger, J.	David Sarnoff			AR	X			
Budinger, T. F.	Lawrence Berkeley Labs			AR	X			
Caine, S.	Dept. of Navy			A				X
Case, D.R.	Dept. of the Air Force			A	X			
Cohen, J.	Jules Cohen Assoc.			C	X			
Deeter, D.F.	Dept. of the Army			A	X			
Delorge, J.O.	Dept. of the Navy			BR	X			
Durham, M.O.	U. of Tulsa			GT	X			
Elson, E.C.	Dept. of the Army			BR	X			
Erwin, D.N.	Dept. of the Air Force			BR	X			X
Fantozzi, G.U.	Florida P&L			TC				
Guy, W.A.	U. of Washington			BR	X			
Heimer, G.	Consutant			C	X			
Hicks, C.W., Jr.	Dept. of the Army			A	X			
Hover, T.	Dept. of the Air Force			A				X
Kerschner, H.F.	Dept. of the Navy			A	X			
Lin, J.C.	U. of Illinois			BR	X			
Maher, E.E.	Dept. of the Air Force			AR	X			
McDermott, T.J.	NY Power Auth.			U/U	X			
Mitchell, J.C.	Dept. of the Air Force			AP	X			
Osepchuk, J.M.	Raytheon Research			TC	X			
Petersen, R.C.	AT&T Bell Labs			TC	X			
Roberts, B.	Dept. of the Army			A	X			
Rose, R.	Dept. of the Navy			A	X			
Schwann, H.P.	U. of PA			BR	X			
Spaulding, N.E.	Houston P&L			U/U	X			
Steele, J.A.	Dept. of the Army			A				X

(3-8) Where:
Not Returned = No ballot received after second request

* See attached sheet for return

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC

BALLOT SUMMARY

IEEE Project No. _____

SPONSOR: SCC-28 BALLOTING COMMITTEE: SCC-28 DATE: 05-14-91

NAME	COMPANY	Classification			Vote			
					Yes	No	Abstain	Not Ret.
Storm, F.K.	U. of Wisconsin			AR	X			
Swicord, M.	FDA/CDRH			BR		X		
Yacovissi	Dept. of the Navy			A	X			
Zipse, D.	FMC Corp.			IC	X			
Sassen, H.	FDA/CDRH			BR	X			

A = ADMINISTRATIVE
AR = APPLIED RESEARCH
BR = BASIC RESEARCH
C = CONSULTANT
GI = GENERAL INTEREST
IC = INDUSTRIAL/COMMERCIAL
R = REGULATORY
U/U = USER/UTILITY

Memo: (3-9)